THE SILVERINSTITUTE

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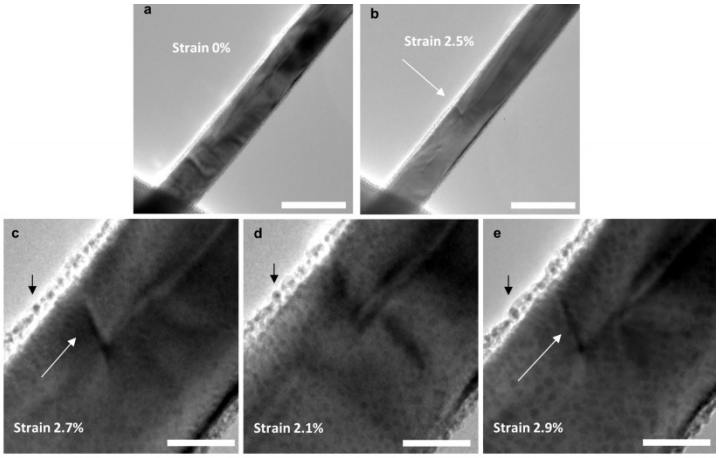
# Silver News



## Silver Nanowires Could Replace Expensive Compound Used in Touchscreens, Televisions




NANO LETTERS

These electron microscope photos show increasing stress on silver nanowires, a resultant breakdown, and their 'self-healing' when the stress is removed. Image (a) shows a 61 nm nanowire initially free of dislocations that was loaded until a defect nucleation event (b) was observed (white arrow). (c) Subsequently, the loading process was stopped and the defect was imaged at high resolution. Note the black arrow as a point of reference for subsequent images. (d) Keeping the same magnification, unloading is performed, leading to the disappearance of the defect. Scale bars: a-b 100 nm, c-e, 20 nm. Further loading (e) leads to the nucleation of the defect at the same location.

Indium tin-oxide is widely used in touchscreens, plasma televisions and flexible electronics because of its high electrical conductivity and optical transparency. However, this compound is becoming more expensive and engineers are seeking an alternative.

One substitute may be silver nanowires embedded in flexible polymers, according to Professor Horacio Espinosa at Northwestern University's McCormick School of Engineering. Silver nanowires contain many of the same properties as indium tin-oxide, such as transparency and conductivity, but a lack of knowledge about these characteristics is hindering development.

Espinosa hopes to change that by studying how the material holds up to 'cyclic loading,' fatigue caused by fingers stabbing at a screen and bending of items that require flexibility.

"Cyclic loading is an important material behavior that must be investigated for realizing the potential applications of using silver nanowires in electronics," Espinosa said. "Knowledge of such behavior allows designers to understand how these conductive films fail and how to improve their durability."

Espinosa and his team have subjected silver nanowires thinner than 120 nanometers to varying tension and watched their deformation with electron microscopes. This mimicked what the wires might endure if they were used in consumer electronic devices. The researchers discovered that seemingly permanent deformation was partially 'healed' and the damage disappeared upon the release of stress. These results indicate that silver nanowires could potentially withstand strong cyclic loads for long periods of time, which is a key trait needed for flexible electronics. "These silver nanowires show mechanical properties that are quite unexpected," Espinosa noted. The next step is to test the silver nanowires under conditions that simulate millions of bends and flexes.

The findings were featured in the journal Nano Letters.

# The British Royal Mint Refinery Revives Brand; Sells Silver and Gold Bars to Public

For the first time in 47 years, the public will have the opportunity of owning newly-minted silver and gold bars bearing the 'RMR' initials, the brand of Britian's Royal Mint Refinery.

"The Royal Mint's reputation as a bullion provider is well respected across the world, so we are thrilled to be able to add minted bars bearing the historic Royal Mint Refinery marquee to our bullion range," said Lisa Elward, The Royal Mint's Head of International Sales and Bullion, in a prepared statement. "The combined heritage and integrity of the two brands is an added reassurance to customers looking for a cost-effective way of buying gold and silver from a trusted source."

RMR gold bars are VAT free for individuals and meet the criteria for UK citizens to buy them through a Self-Invested Personal Pension (SIPP) or Small Self-Administered Scheme (SSAS) and benefit from up to 45% tax relief on their gold purchases. Silver bars are subject to standard VAT, currently 20%. However, for purchases from outside of the European Union, VAT will not be charged, but may be assessed for import or customs fees, depending on the laws of the particular countries.

Silver bars are available in 100 gram units and gold bars from 1 to 100 gram units. As well as bearing the RMR logo, the bars will also be given a unique serial number.

The Royal Mint Refinery marquee dates back to 1852, Royal Mint officials said. It was operated for more than 100 years by N.M. Rothschild and Sons until bullion production ceased in 1968.


ROYAL MINT

The public can now buy silver bars from the Royal Mint.

# 3-D Printer Prints Plastic and Silver Inks on Same Object; U.S. Government-Sponsored Project in Progress

A 3-D printer that can print plastics as well as conductive silver inks at the same time and allows users to produce customized electronic devices like quadcopters (a four-rotor helicopter), electromagnets and fully functional electromechanical assemblies is now commercially available. 3-D printing will allow these products to be produced quickly and with less cost.

The Voxel8, which has been under development for more than a decade, (See *3-D Printers With Nanosilver Can Build Batteries Into Tiny Electronic Products*, December, 2013, *Silver News*), is now available for sale to consumers. The cost is $US 8,999 and shipping will begin later this year from the Somerville, Massachusetts, company.

The key to the printer's ability to print both plastic and conductive silver inks is software that tells the computer's interchangeable cartridges when to print each medium. The software, developed by CAD software mainstay Autodesk, can also pause the printer at predetermined points to allow the user to insert any electronic components such as switches into the 3-D printed object.

The printer can produce objects up to 4x6x4 inches (10x15x10 cm). Currently, the printer supports standard PLA plastic (a biodegradable thermoplastic polyester) and conductive silver, but the developers expect that more printable materials will be available in the future.

Already, MITRE Corporation, a not-for-profit organization that operates research and development centers sponsored by the U.S. Federal Government, is working with Voxel8 developers to explore ways to produce unique phased-array antennas for a government sponsor.

Prior to identifying Voxel8's technology, MITRE was unable to build the novel phased-array structure using existing manufacturing methods. "When I saw what Voxel8 could do, I was hopeful that their technology could be the solution to our problem – that we could realize the new phased-array antenna using Voxel8's 3-D printer," said Jamie Hood, a mechanical engineer in MITRE's Mechanical & Reliability Engineering Department. MITRE and the Voxel8 team plan to build a prototype antenna this spring, Hood said.

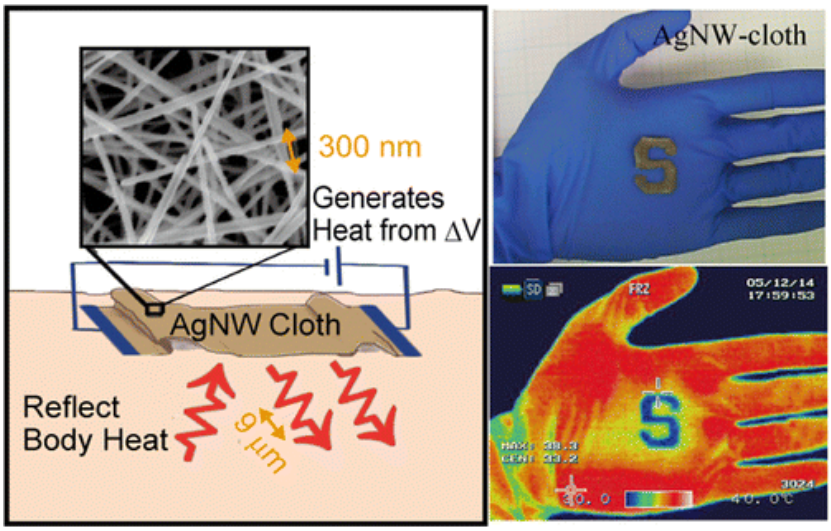

Click on the image to play a video of the Voxel8 3-D printer in action.

# Save Money, Keep Warm by Wearing Nanosilver Clothing

Indoor heating accounts for about half of the world's energy consumption, according to the International Energy Agency, so researchers at Stanford University wondered if wearing clothes with imbedded silver nanowires would allow people to lower their thermostats. These clothes would also keep people comfortable in cold weather outside.

The research team's testing shows that 'personal thermal management' clothing might reduce the need for higher indoor temperature settings while eliminating the need for bulky clothing, like sweaters, traditionally used to keep warm inside. The team notes in their research paper: "The metallic nanowires form a conductive network that not only is highly thermal insulating because it reflects human body infrared radiation but also allows Joule [electrical] heating through electricity to complement the passive insulation. The breathability and durability of the original cloth is not sacrificed because of the nanowires' porous structure. This nanowire cloth can efficiently warm human bodies and save hundreds of watts per person as compared to traditional indoor heaters."

Yi Cui, the lead scientist, noted that the cloth is breathable and the bendable silver nanowires allow it to be flexible like regular textiles used for clothing. He says it will cost about US$1 for enough silver to attire an entire person and that coated clothing could save the average person up to US$200 annually on heating costs. The researchers say it could take a few years for the product to be available to the public.




NANO LETTERS

The image on the left shows how much body heat is reflected back to the wearer of silver nanowire clothing. On the right, a detector shows how much heat is retained with nanowire clothing compared to an ungloved hand.

# Sales of 2014 American Eagle Silver Bullion Coins Hit Record in 2014

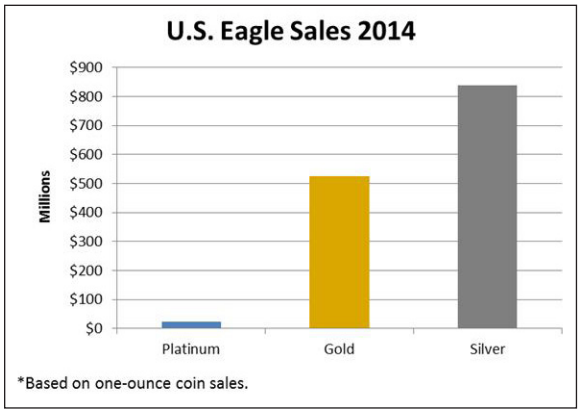
Sales of U.S. American Eagle Silver Bullion coins soared last year beating the previous milestone established in 2014, according to U.S. Mint statistics.

The U.S. Mint announced that 2014 sales of American Eagle Silver Bullion coins reached 44,006,000 ounces, compared to 42,675,000 in 2013, driven by a strong demand in the fourth quarter. Sales of the American Eagle Silver Bullion one-ounce coin outpaced those of the one-ounce American Eagle Gold and Platinum coins. Indeed, Silver Eagles eclipsed Gold Eagles' sales by 59 percent.

Other mints reported strong sales, too. The Royal Canadian Mint (RCM) posted healthy demand for its silver bullion products last year, selling out its minting of one million of the Bald Eagle coins from its new Canadian Birds of Prey 99.99 percent pure silver coins series. (See *Royal Canadian Mint Issues Second in Series of Four Birds of Prey Coins,* August, 2014 *Silver News.*) The RCM said its flagship Silver Maple Leaf Bullion coin continues to generate solid customer interest.

Australia's Perth Mint reported that while total silver sales were down 13.5 percent year-on-year, largely due to a sales tax increase in Europe, there was an increase in buying as the price came off through the second half of the year, producing 20.8 percent higher sales over the first half.

For more details visit the Silver Institute website.




MINT STATISTICS

Sales of U.S. American Eagle Silver Bullion coins soared past gold and platinum products.

# Silver Helps Speed Up Touchscreen Production

Touchscreens are easy to use but challenging to manufacture because their inner workings are more complex than many everyday users might imagine.

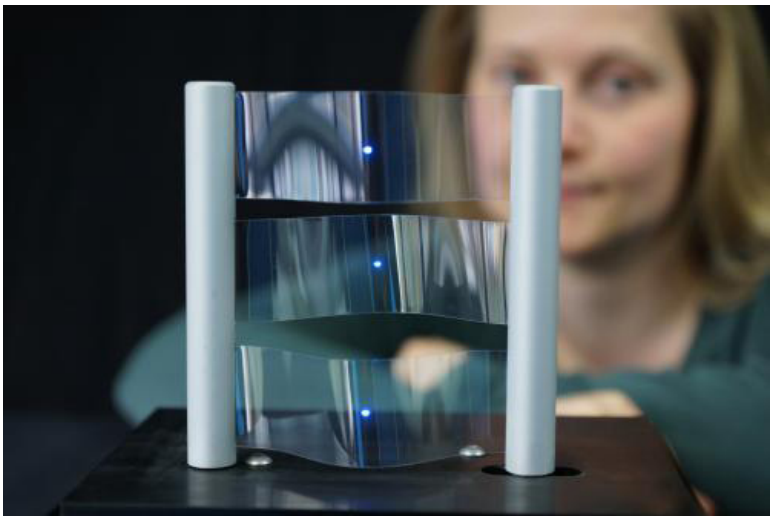
When you poke at a touchscreen, a microscopic conductor track detects the touch and sends that signal to larger conductor tracks on the outside of the screen. These macroscopic tracks collect and aggregate that signal with those coming from other microscopic conductor tracks. It's similar to the way small roadways feed traffic into larger highways.

Until now, it took several production stages to create these different-sized tracks. However, at the Leibniz-Institute for New Materials in Saarbrücken, Germany, researchers have introduced a process to construct a basic building block of touchscreens in one step.

The one-step process relies on something called photometallization. When exposed to ultraviolet light, in conjunction with a photoactive layer, colorless silver compounds turn into electrically-conductive silver. The silver compound can be applied in the form of tracks or other structures to plastic films or glass. Tracks of various sizes, down to the smallest size of a 1000th of a millimeter, can be created in this way, researchers said.

The foils or glass are first coated with a photoactive layer of metal oxide nanoparticles. "We then apply the colorless, UV-stable silver compound," said Peter William de Oliveira, Head of the Optical Materials Program Division. The exposure of this series of layers has the effect that the silver compound on the photoactive layer decomposes and the silver ions are reduced to metallic, electrically-conductive silver.

The advantages of this method are that it's quick, flexible, variable in scale, low in cost, environmentally friendly, and there is no need for any further post-treatment process steps, researchers said.



INM

Producing flexible conductive film for touchscreens was traditionally a multi-step process. Silver compounds are cutting the steps to one.

# Silestone Offers Silver Ion Protection for its Countertops

*Silestone P+*, developed by Cosentino for its Silestone brand of countertops, is the company's first quartz offering silver ion protection against bacteria, according to company officials. The countertops are available in a variety of colors and patterns.

Company officials note that active agents are incorporated in the material during the manufacturing process and are distributed evenly throughout the product. Silestone countertops are composed of 94 percent natural quartz.

# Diebold, Corning Pioneer World's First Antimicrobial Touch Screen for Automated Teller Machines

Public touchscreens have a high germ factor. A report by WJLA-TV in Washington, DC, for example, showed that public touchscreens, such as those used in ATMs, ticket kiosks, supermarket checkouts and movie theaters, harbored elevated germ levels. Other tests on public facilities showed similar results.

In an attempt to alleviate germaphobes' fears about ATMs, Diebold, Inc. and Corning, Inc. have joined to introduce the first ATM touch screen featuring antimicrobial Corning Gorilla Glass, similar to that now used in smartphone screens. See *Corning Adds Silver to Gorilla Glass First EPA-Registered Antimicrobial Cover Glass,* February, 2014, *Silver News*.)

The glass is formulated with ionic silver to prohibit the growth of algae, mold, mildew, fungi and bacteria on its surface. A prototype of the ATM was shown at the International Consumer Electronics Show in January.

"Touched by hundreds of users every day, the ATM is a universally-shared touch device," said Joydeep Lahiri, division vice president and program director, Specialty Surfaces, Corning Incorporated, in a prepared statement. "Therefore, toughness and antimicrobial protection are desired attributes. For Diebold ATMs, Antimicrobial Corning Gorilla Glass will deliver lifelong antimicrobial activity that won't compromise toughness or optical clarity."

Diebold plans to offer Antimicrobial Corning Gorilla Glass as an option on its expanding line of self-service terminals, as well as a retrofit option for existing ATMs.

# Upcoming Events

## World Silver Survey 2015

## 25th Anniversary

The Silver Institute will publish the 25th edition of *World Silver Survey* on May 6, 2015. *World Silver Survey 2015* is produced for the Silver Institute by GFMS Thomson Reuters, the London-based analysts of global precious metals markets. This annual report is the most authoritative source of data and statistics on global silver supply and demand. It provides insightful and detailed information on key aspects of the industry.


14th China International Silver Conference 2015
16 - 18 September 2015
Shanghai, China

The Silver Institute is pleased to announce that the 14th China International Silver Conference (CISC) will be held in Shanghai, China, from September 16-18, 2015. The CISC is the most prominent global international silver conference and offers attendees an opportunity to meet with key Chinese and international silver market participants.

Silver Industrial Conference
Washington DC October 28-29

The Silver Institute will host the 2015 Silver Industrial Conference in Washington, D.C., on October 28-29. The event is dedicated to the metal's ever-growing role in the industrial world, and will bring together leading executives from throughout the wide-ranging silver industry and supply chain, to focus attention on future commercial and industrial developments, and the changing demands of the silver marketplace. More information will be available in the near future.

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